Paper No. 23

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte HEINRICH SCHLANGENOTTO,
KARL-HEINZ SOMMER
and
FRANZ KAUSSEN

Appeal No. 96-0341
Application 08/005,760[1]

ON BRIEF

Before HAIRSTON, JERRY SMITH, and CARMICHAEL, Administrative Patent Judges.

HAIRSTON, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1 through 14. In an Amendment After Final (paper number 15), claim

[1] Application for patent filed January 19, 1993.

3 was amended. In an Advisory Action (paper number 16), the examiner indicated that the amendment had the effect of overcoming the indefiniteness rejection of claim 3, and that claim 3 was allowed. Accordingly, claims 1, 2 and 4 through 14 remain before us on appeal.

The disclosed invention relates to a power diode that has a base zone that is divided into at least two diode regions. The first region of the base zone is of a first predetermined thickness, and is dimensioned for a given blocking voltage. The second region of the base zone is of a second thickness that is greater than the first predetermined thickness by at least a factor of 1.4. The first diode region has a first area and a first minority carrier lifetime, and the second diode region has a second area and a second minority carrier lifetime. The diode region areas are dimensioned such that a forward current flowing through the first diode is greater than a forward current flowing through the second diode by at least a factor of 2. According to the disclosed and claimed invention, a greater amount of forward current flows through the first diode region because it is thinner than the second diode region.

Claim 1 is the only independent claim on appeal, and it reads as follows:

1. A power diode, comprising:

at least one semiconductor body having a base zone of a first conductivity type and a given doping level, a cathode zone of the first conductivity type and a doping level higher than the given doping level, and an anode zone of a second conductivity type opposite the first conductivity type and a doping level higher than the given said base zone having at least a first region with a first predetermined thickness and being dimensioned for a given blocking voltage and a second region with a second thickness being greater than the first predetermined thickness by at least a factor of 1.4;

the first region forming a base zone of a first diode and the second region forming a base zone of a second diode, said first diode having a first area and a first minority carrier lifetime, the second diode having a second area and a second minority carrier lifetime, said areas being dimensioned such that a forward current flowing through said first diode is greater than a forward current flowing through said second diode by at least a factor of 2.

The reference relied on by the examiner is:

Naito et al. (Naito) 0,103,138 Nov. 19, 1987
(European Patent Specification)

Claims 1, 2 and 4 through 12 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Naito.

Claims 1, 13 and 14 stand rejected under 35 U.S.C. § 103 as being unpatentable over Naito.

Reference is made to the brief and the answer for the respective positions of the appellants and the examiner.

OPINION

We have carefully considered the entire record before us, and we will reverse all of the rejections.

The examiner indicates (Final rejection, pages 3 and 4) that Figure 3 in Naito discloses a semiconductor diode that comprises: a base zone 42 of a first conductivity type [n-], and of a given doping level; a cathode zone 51 of the first conductivity type [n+], and of a doping level higher than the given doping level; an anode zone 31 and 32 of a second conductivity type [p and p+, respectively] opposite to the first conductivity type, and of a doping level higher than the given doping level; a first region [between zone 32 and the interface of zones 41 and 42] with a first predetermined thickness [3µm], and being "inherently dimensioned for a given blocking voltage;" and a second region [between zone 31 and the interface of zones 41 and 42] with a second thickness [6µm] being greater than the first predetermined thickness by at least a factor of 1.4. According to the examiner (Final rejection, page 4), "the first region forming a base zone of a first diode (II) and the second region forming a base zone of a second diode (I), said first diode having a first area and a first minority carrier lifetime, the second diode having a second area and a second minority carrier lifetime, said area being inherently dimensioned such that forward current flowing through said first diode is greater than a forward current flowing through said second diode by at least a factor of 2." In other

words, the examiner is of the opinion that Naito, like the disclosed and claimed invention, has a forward current flowing through the first diode (with the thinner base region under zone 32) that is greater than the forward current flowing through the second diode (with the thicker base region under zone 31).

In Naito, the p-type layer 3 [anode zone] is composed of "a first portion 31 which is thin in thickness and low in concentration and second portions 32 which have a higher concentration than the first portion 31 and are formed more deeply than the first portion 31" (page 3, lines 33 through 36). As a result of these impurity concentrations, when a positive voltage is applied to the anode electrode 1 with respect to the cathode electrode 2 to create a forward bias condition, "the main current flows mainly through the first laminated structure I wherein the first portion 31 serves as one of the emitters" (emphasis added)(page 4, lines 7 through 9). Naito further discloses that:

> When the first laminated structure I thus becomes the main current path, minority carriers contribute to operation between the first portion 31 and the anode electrode 1 because the diffusion potential is low and the first portion 31 is thin. And the barrier between the first portion 31 and the anode electrode is not an obstacle to the carrier movement (emphasis added) (page 4, lines 9 through 12).

In view of the foregoing, it is evident from the disclosure of Naito that the forward current flowing through the second diode is greater than the forward current flowing through the first diode because the first portion [zone] 31 is thinner than portion [zone] 32, and because the diffusion potential of portion [zone] 31 is lower than the diffusion potential of portion [zone] 32. To be more exact, Naito has more forward current flowing through the thicker base region (i.e., the region under portion/zone 31) in the second diode than through the thinner base region (i.e., the region under portion/zone 32) in the first diode. Such a forward current flow in Naito is opposite to the claimed greater forward current flow through the thinner base region in the first diode.

In view of the foregoing, the examiner has mistakenly concluded that the areas of the Naito diode device are inherently dimensioned such that "a forward current flowing through said first diode is greater than a forward current flowing through said second diode by at least a factor of 2" (claim 1). The claimed forward current flows can never occur in Naito. It is for this reason that we are reversing the 35 U.S.C. § 102(b) rejection of claims 1, 2 and 4 through 12, and the 35 U.S.C. § 103 rejection of claims 1, 13 and 14.

DECISION

The decision of the examiner is reversed because all of the rejections of record have been reversed.

REVERSED

KENNETH W. HAIRSTON Administrative Patent Judge	)
JERRY SMITH Administrative Patent Judge	) BOARD OF PATENT) APPEALS AND) INTERFERENCES
JAMES T. CARMICHAEL Administrative Patent Judge	)

LERNER AND GREENBERG, P.A.
P.O. Box 2480
Hollywood, FL 33022-2480